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RESPONSIBLE FISH UTILIZATION

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1998

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PREPARATION OF THIS DOCUMENT

The main text of these guidelines was prepared by Ivor Clucas whilst seconded to the Fish Utilization and Marketing Service of FAO under its Programme of Cooperation with Academic and Research Institutions, from the Natural Resources Institute of the University of Greenwich, UK. Majority funding for this secondment was from the United Kingdom's Department for International Development (DFID).

These guidelines have been drafted taking into account the Technical Notes on Article 11 prepared by H.H. Huss and P.A. Messerlin for the Fisch '96 International and Seafood Europe Industry Workshop held in Bremen, Germany (6 June 1996) and comments on those notes received following the workshop. The draft text was then circulated both within FAO and many experts world-wide for further comment.

It is stressed that these guidelines have no formal legal status and are intended to provide general advice in support of implementation of Article 11.1 **Responsible Fish Utilization** of the Code of Conduct for Responsible Fisheries. These guidelines are designed as a starting point for further revision, the preparation of more specific texts for specific types of fishery or regions and to assist in further dissemination, understanding and implementation of the Code world-wide.

Distribution:

All FAO Members and Associate Members
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FAO Fisheries Officers in FAO Regional Offices
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ABSTRACT

These guidelines have been produced to support the implementation of the Code of Conduct for Responsible Fisheries particularly with regard to the need for responsibility in the post–harvest sector of the fish producing industry.

The industry that produces fish for food has three major areas of responsibility:

- to the consumer of the food to ensure that it is safe to eat, is of expected quality and nutritional value,
- to the resource to ensure that it is not wasted and
- to the environment to ensure that negative impacts are minimized.

In addition the industry has a responsibility to itself to ensure the continued ability of many millions of people throughout the world to earn a gainful living from working within the industry.

Article 11.1 of the Code of Conduct for Responsible Fisheries and other related parts of the Code are concerned particularly with these responsibilities. This publication provides annotation to and guidance on these articles to assist those charged with implementation of the Code to identify possible courses of action necessary to ensure that the industry is conducted in a sustainable manner.

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Abbreviations

Bt	Bacillus thuringiensis
CAC	Codex Alimentarius Commission (of FAO/WHO)
CFC	Chlorofluorocarbon
CITES	Convention on International Trade in Endangered Species
COFI	Committee on Fisheries (of the FAO)
DDT	Dichlorodiphenyltrichloroethane [1,1,1-trichloro-2,2-bis-(p-chlorophenyl)ethane]
DFID	Department for International Development (of UK government)
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
HACCP	Hazard Analysis Critical Control Point
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon (not containing chlorine or bromine ions)
JMPR	Joint Meeting on Pesticide Residues (of FAO/WHO)
NGO	Non-governmental Organization
UNCED	United Nations Conference on Environment and Development
WHO	World Health Organization
WTO	World Trade Organization

BACKGROUND

From ancient times, fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity. However, with increased knowledge and the dynamic development of fisheries, it was realized that living aquatic resources, although renewable, are not infinite and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the growing world's population was to be sustained.

The adoption in 1982 of the United Nations Convention on the Law of the Sea provided a new framework for the better management of marine resources. The new legal regime of the oceans gave coastal States rights and responsibilities for the management and use of fishery resources within the areas of their national jurisdiction, which embrace some 90 percent of the world's marine fisheries.

In recent years, world fisheries have become a dynamically developing sector of the food industry, and many States have striven to take advantage of their new opportunities by investing in modern fishing fleets and processing factories in response to growing international demand for fish and fishery products. It became clear, however, that many fisheries resources could not sustain an often uncontrolled increase of exploitation.

Clear signs of over-exploitation of important fish stocks, modifications of ecosystems, significant economic losses, and international conflicts on management and fish trade threatened the long-term sustainability of fisheries and the contribution of fisheries to food supply. Therefore, the Nineteenth Session of the FAO Committee on Fisheries (COFI), held in March 1991, recommended that new approaches to fisheries management embracing conservation and environmental, as well as social and economic, considerations were urgently needed. FAO was asked to develop the concept of responsible fisheries and elaborate a Code of Conduct to foster its application.

Subsequently, the Government of Mexico, in collaboration with FAO, organized an International Conference on Responsible Fishing in Cancún in May 1992. The Declaration of Cancún endorsed at that Conference was brought to the attention of the UNCED Summit in Rio de Janeiro, Brazil, in June 1992, which supported the preparation of a Code of Conduct for Responsible Fisheries. The FAO Technical Consultation on High Seas Fishing, held in September 1992, further recommended the elaboration of a Code to address the issues regarding high seas fisheries.

The One Hundred and Second Session of the FAO Council, held in November 1992, discussed the elaboration of the Code, recommending that priority be given to high seas issues and requested that proposals for the Code be presented to the 1993 session of the Committee on Fisheries.

The Twentieth Session of COFI, held in March 1993, examined in general the proposed framework and content for such a Code, including the elaboration of guidelines, and endorsed a time frame for the further elaboration of the Code. It also requested FAO to prepare, on a "fast track" basis, as part of the Code, proposals to prevent reflagging of fishing vessels which affect conservation and management measures on the high seas. This resulted in the FAO Conference, at its Twenty-seventh Session in November 1993, adopting the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, which, according to FAO Conference Resolution 15/93, forms an integral part of the Code.

The Code was formulated so as to be interpreted and applied in conformity with the relevant rules of international law, as reflected in the United Nations Convention on the Law of the Sea, 1982, as well as with the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly.Migratory Fish Stocks, 1995, and in the light of, *inter alia*, the 1992 Declaration of Cancún and the 1992 Rio Declaration on Environment and Development, in particular Chapter 17 of Agenda 21.

The development of the Code was carried out by FAO in consultation and collaboration with relevant United Nations Agencies and other international organizations, including non-governmental organizations.

The Code of Conduct consists of five introductory articles: Nature and Scope; Objectives; Relationship with Other International Instruments; Implementation, Monitoring and Updating and Special Requirements of Developing Countries. These introductory articles are followed by an article on General Principles, which precedes the six thematic articles on Fisheries Management, Fishing Operations, Aquaculture Development, Integration of Fisheries into Coastal Area Management, Post-Harvest Practices and Trade, and Fisheries Research. As already mentioned, the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas forms an integral part of the Code.

The Code is voluntary. However, certain parts of it are based on relevant rules of international law, as reflected in the United Nations Convention on the Law of the Sea of 10 December 1982. The Code also contains provisions that may be or have already been given binding effect by means of other obligatory legal instruments amongst the Parties, such as the Agreement to Promote Compliance with Conservation and Management Measures by Fishing Vessels on the High Seas, 1993.

The Twenty-eighth Session of the Conference in Resolution 4/95 adopted the Code of Conduct for Responsible Fisheries on 31 October 1995. The same Resolution requested FAO *inter alia* to elaborate as appropriate technical guidelines in support of the implementation of the Code in collaboration with members and interested relevant organizations.

INTRODUCTION

1. The Code of Conduct for Responsible Fisheries lays out ideas of responsibility in three main areas:

- responsibility to the environment;
- responsibility to the industry that produces fish and fishery products;
- responsibility to the consumer of fish.

2. These three areas of responsibility run through all the articles of the Code in one way or another but within Article 11 (Post–harvest Practices and Trade) the responsibilities to the consumer are highlighted. The responsibilities to the three areas above are inter-linked and in many ways being responsible to one implies responsibility to the other two. It must be remembered of course that the Code of Conduct relates to an industry, an industry that would cease to exist if no one purchased and, in the vast majority of cases, ate fish - in other words, if there were no consumers.

3. Under the **General Principles** of the Code, some of these responsibilities are also outlined:

> ***6.7 The harvesting, handling, processing and distribution of fish and fishery products should be carried out in a manner which will maintain the nutritional value, quality and safety of the products, reduce waste and minimize negative impacts on the environment.***

4. Although most of the articles of the code are written such that they put responsibility for implementation on governments and states it is also implied that the code is a set of standards for the whole of the fisheries sector. Article 2, which lists the objectives of the Code states that it provides standards of conduct for all persons involved in the fisheries sector.

The need for responsibility in post–harvest fisheries activities

5. Fisheries have substantial social, economic, nutritional and food security importance. FAO estimates that in 1994 there were at least 30 million people directly engaged in primary production of fish either in capture from the wild or in aquaculture (FAO Fishery Information, Data and Statistics Unit, 1997). The table below compares the primary production of fish by each region with the number of persons involved in the production of that fish. It shows that the numbers of persons involved and the scale of operations is unevenly spread across the globe with a high concentration of participants at low levels of production in Asia. The average production per person in Asia for instance is less than two tonnes per year whereas in Europe it is nearer thirty tonnes. These figures illustrate the degree of industrialisation of fishing activities in the various continents and also the very important part played by "small–scale"

fisheries in providing food particularly in Africa and Asia. The high volume of fish caught but relatively low numbers of people employed in the industrial fisheries for small pelagic fish species, destined mainly for animal feeds, in South America probably explain the high ratio of production per person for this region.

Continent	Nominal production (tonnes) 1990[1]	Percentage of production	Number of persons engaged in production[2]	Percentage of persons	Production per person tonnes/year
Africa	5,138,400	5.3	1,857,692	6.5	2.8
Asia	46,080,200	47.1	24,252,822	85.0	1.9
Europe	11,457,600	11.7	391,781	1.4	29.2
North Am	9,584,400	9.8	844,675	3.0	11.3
South Am	14,453,900	14.8	785,556	2.8	18.4
Former USSR	10,389,100	10.6	251,000	0.9	41.4
Oceania	747,800	0.8	143,701	0.5	5.2
TOTAL	**97,851,400**		**28,527,227**		**3.4**

Sources [1] FAO 1997a. [2] FAO Fisheries Information, Data and Statistics Unit 1997.

6. In addition to those people involved in direct primary production of fish there are those involved in the ancillary industries such as boat building, gear making, ice production, packaging, marketing, distribution, refrigeration, engineering etc. and others who are involved in research, development and administration connected with the industry. There are no similarly detailed estimates of the numbers of people involved in processing, marketing and distributing the products of fishing and aquaculture. However, there is no doubt a similar pattern of small–scale, family businesses and dependency on low volume throughputs in the post–harvest sector in Asia and Africa as there is in the primary production sector.

7. It is quite probable that for every one person involved in primary production there are at least 4 jobs created in these other activities, including post–harvest, in other words, up to 150 million jobs in what is commonly referred to as "the fishing industry". These rough figures are for those earning all or part of their living from the fishing industry and can probably be multiplied by at least 3 to give the number of dependants or family members - 450 million, representing perhaps 7 or 8 percent of the world population.

8. World production of fish has been between 100 and 110 million tonnes per annum in recent years with a high of 112 million tonnes in 1995. Of this, roughly 80 million tonnes are used for direct human consumption and almost all of the remaining 30 million tonnes is used for the feeding of animals used for human consumption or for the production of dairy products or eggs which also enter the human food chain. (FAO 1997a and FAO 1997b)

9. Landed value of the products from capture fisheries are estimated at over US$83 000 million with a further US$42 000 million from products of aquaculture operations. In terms of world trade in fish and fishery products over US$52 000 million worth of products crossed national boundaries in 1995 (FAO 1997b). Fifty one percent of this cross border trade is from developing countries. The net receipts of foreign exchange from fishery exports from developing countries have risen from US$5 100 million in 1985 to US$18 000 million in 1995. (FAO 1997c and FAO Inland Water Resources and Aquaculture Service, Fishery Resources Division 1997).

10. Large portions of the world's fishing stocks are fully exploited. Some are over-exploited or depleted and therefore need to be allowed to recover if overall fish production is to be sustained at its present levels in the long term. The growth of aquaculture has to some extent helped to alleviate the problem of static or diminishing supply from traditional resources but with the growth of human populations, there are still likely to be shortfalls in supply. This means per capita supply will diminish and fish prices may rise as a consequence. It is estimated that the demand for fish for all uses will rise to 140 to 150 million tonnes by the year 2010 (FAO 1997c).

11. Reducing the amount of fish that is wasted or lost between capture and consumption relieves some of the pressure that is apparent on fish stocks and thus assists in the sustainable exploitation of the resource.

12. Although there are cases where fish is caught purely for own consumption (subsistence fishing) is exchanged for goods rather than money (barter trade) or caught for sport, a large proportion of fish is caught and processed so that it can be sold. It is apparent, therefore, that the responsible use of the current production is of prime importance to the health of the fishing industry, the fish consuming people of the world and many others whose livelihood depends on fish as food. The industry and infrastructure of world fisheries depends, to a large extent, on the final sale of product between retailer and consumer where fish or fish based products pass in one direction and money passes in the other. Without this final transaction taking place there would be no need for or point in all the previous efforts that have been made to capture or raise the fish, process and preserve it, regulate or manage the fishery, have government and international bodies dedicated to serving the interests of the industry and the people involved in it. Indeed there would be no money flowing into the system to pay for the various inputs required to get the fish to this stage.

13. There are, therefore, ecological, social and economic reasons why it is very important to ensure that, once caught, fish reaches the consumer by the most efficient means and that the final sale is transacted to the satisfaction of both the consumer and the seller, who in this act represents the interests of all the other stake holders in the fishing industry.

14. Other reasons why there is a need to get fish to consumers with minimal loss and with optimal efficiency are related to the fact that it represents a valuable source of nutriment to many people in the world. The ultimate reason for the majority of fishing and fish raising

activities is to contribute to food supplies. Fish is often not considered important in terms of national food security because it contributes little in the way of calories and food security, for a nation, is usually measured in terms of carbohydrate availability per head of population. However people do not live on carbohydrate sources such as grains and tubers alone.

15. At a household and individual level, fish can be nutritionally very important in that it provides a source of easily digested, high quality protein containing essential amino acids, particularly lysine, not necessarily obtainable elsewhere in such high concentrations. In addition the fats that fish contain are high in polyunsaturated fatty acids, particularly omega 3 fatty acids. These have health benefits in protection against cardiovascular disease, assist in brain and nervous system development, in foetal and infant development and seem to offer some protection against diabetes, chronic infections and certain types of cancer.

16. Fish are also sources of vitamins such as B12, A and E and are a major source of naturally occurring vitamin D. Fish also contains important trace elements such as iodine and selenium. Fish is low in sodium an important factor for persons with blood pressure problems who may require low sodium diets. Nutritionally therefore fish has a lot of advantages and where other sources of animal protein are scarce or expensive, such as in less developed areas of the world, fish is often the most important source of dietary protein.

17. Although there are restrictions on the consumption of some shellfish and non-scaly fish for some Muslim and Jewish traditions fish is generally not associated with taboos or religious restrictions linked with other animal products. Fish may also be acceptable to those who will not eat meat from warm-blooded animals. In many less developed countries fish also represent an affordable source of animal protein which is not only cheaper but is preferred as part of local and traditional recipes. Locally produced fish and fishery products are generally cheaper than other animal protein sources such as beef, pork, goat or sheep and are often transported as preserved products to rural communities where other sources of animal protein are not generally available at the right price for "everyday consumption".

18. The contribution of fish to nutrition varies considerably from place to place depending on the eating habits and traditions of groups of people. On a world-wide basis the FAO "Food Balance Sheets" (Laureti 1996) show that in 1993 apparent supply of fish was 13.4 kg of whole fish per person. This represents 15.6 percent of animal protein consumption. In low-income food deficit countries, however, only 9.6 kg of fish are available per head but this represents over 20 percent of the animal protein available. This illustrates that fish are often relatively more important in these poorer countries than other sources of animal protein. There can be vast differences between countries depending on availability of fish, the availability of other foods and traditions and eating habits. In the Comoros Islands, for instance, 21.3 kg of fish is available per head per year representing 61.5 percent of animal protein intake, in Canada roughly the same amount of fish is available per head (22.5 kg) but it represents less than 10 percent of animal protein intake for Canadians. This indicates that Canadians have a much higher animal protein intake altogether and that fish is more important as an item of food to Comorians than to Canadians. For Comorians fish probably represents a cheap and available

source of animal protein, where as in Canada the fish intake adds to an already wide range of food choices.

Constraints to optimal use of fish once caught

19. Fish spoils and becomes inedible more rapidly than almost any other food. Unless consumed soon after death it soon becomes unacceptable and therefore may be lost as an item of nutritional value. Preservation and processing techniques involving reduction of temperature (chilling and freezing), heat treatment (canning, boiling and smoking), reduction of available water (drying, salting and smoking) and changing the storage environment (packaging and refrigeration) can reduce the rate at which spoilage happens and thus allow fish to be distributed and marketed on a world-wide basis. However, when things go wrong with the infrastructure and mechanisms designed to preserve the product, fish can be lost to the system because they become spoilt before they can reach the consumer. Examples might include the disruption of power supplies causing interruption in supplies of ice or freezing and cold storage facilities for low temperature preservation, the failure of packaging materials to keep dried fish dry, faulty machinery in the canning industry producing incomplete sterilisation, failure of transport infrastructure in distributing a product to market or the breakdown of a vehicle carrying perishable goods.

20. The fragility of fresh fish as a food item also means that if marketing conditions are disrupted or changed from normal, fish that cannot to be sold within its designated shelf-life becomes spoilt and so has to be discarded. This is particularly a problem with fish that is not preserved in any way and at tropical ambient temperatures may only have a few hours of useful storage life remaining by the time it reaches the retail stage. In many cases if it is not sold today, it will no longer be edible tomorrow.

21. The diversity of organisms present in the aquatic environment is huge. Capture fisheries are generally unable to perfectly select only those specimens, in terms of species and size, for which they have a market or which they are allowed to catch under the terms of a management system designed to regulate and protect the fishery in which they operate. This means that fish for which there is no market or which the law prohibits from capture or landing can and often is returned to the water in a dead or dying state. This discarded catch may contain fish that could be used for human food but, because there is no existing market, it is wasted. The amount of discarded catch depends on a large number of factors including the type of fishery, type of gear, seasonal variations and the skill and experience of the fishing operator.

22. There are many thousands of different species of fish available in the seas, rivers and lakes of the world. As a consequence there are many thousands of different types of food stuffs derived from fish that require preservation and processing in order to reach their eventual consumer in optimum condition and with minimum loss.

23. Although the general principles of fish preservation and processing are the same for the majority of products and species and are transferable between types, each type has its own characteristic composition, size, shape and intrinsic chemistry. In addition the physiological

condition and therefore the chemical make up of a particular specimen can depend on where it is caught, when it is caught, whether it is male or female, its age and maturity and other factors beyond the control of the catcher of the fish.

24. In aquaculture systems, of course, these factors are much more easily controlled and the post–harvest changes in the products from aquaculture should be more easily determined and predicted. However the variety of raw material entering the basket of food generally known as **fish**, makes the need for research and development of post–harvest systems for handling this raw material of prime importance. This is particularly so with the exploitation of novel species and stocks for which the handling and nutritional properties may not be known.

25. Fish as food, like all food stuffs, runs the risk of causing illness of the consumer if measures are not taken to prevent or eliminate contamination from pathogenic micro-organisms, toxins or contaminants. The safety of fish as food is an all important aspect of the need to protect fish consumers and ensure the sustainability of the industry. Without consumer confidence in the safety of fish as food the demand can collapse having a knock on effect to the rest of the industry. It only takes a minor publicised occurrence of food poisoning, for example, to cause drastic economic effects for the whole industry as consumers stop buying fish.

THE CODE OF CONDUCT ARTICLE 11

26. Article 11 of the Code of Conduct for Responsible Fisheries is divided into three sections as follows:

1. Responsible Fish Utilization
2. Responsible International Trade
3. Laws and Regulations Relating to Fish Trade

These guidelines deal specifically with the first of these sections - **Responsible Fish Utilization.**

Related articles of the Code

27. Post–harvest aspects and responsibilities in fisheries are mainly covered in Article 11.1 (Responsible Fish Utilization) however there are a number of items in the Code outside Article 11 which also have implications for responsible fish utilization.

These include:

- Article 8.8 concerned with the phasing out and correct disposal of ozone depleting substances particularly in refrigeration systems,
- Article 8.9.1d concerned with the minimisation of pollution from fishing enterprises at fish landings and harbours,
- Article 9.4.7 concerned with the incorporation of food safety and quality maintenance systems in aquaculture enterprises,
- Article 8.4.4 concerned with the promotion of appropriate technology to make best use and care of the retained catch in fishing operations, thus emphasising the need to assure appropriate handling systems on board boats as well as land based operations,
- Articles 12.7 and 8 which mention the need for research into optimum utilization of fish as food and the need to conduct research so that fish is safe to eat.

28. Mention will be made of these articles, where appropriate, in the following paragraphs, but generally they are less specific than the provisos of Article 11 and so are covered by that article.

29. In some cases there are overlaps and some duplication between the sub-articles and paragraphs that deal with the same responsibilities but from different viewpoints. For instance articles 11.1.1 to 4 are concerned primarily with the responsibility towards the consumer of fish and fishery products, articles 11.1.6, 7, 8c, 11 and 12 outline responsibilities towards the environment and articles 11.1.5, 6, 8a & b, 9 and 10 are concerned with the increased utilization of fish and assisting the industry.

Article 11.1 - Responsible Fish Utilization

30. The following sections deal with Article 11.1. on a paragraph by paragraph basis. The number and wording of the article itself is highlighted followed by the guidance notes.

11.1.1 States should adopt appropriate measures to ensure the right of consumers to safe, wholesome and unadulterated fish and fishery products.

31. This article specifies that consumers have a right to safe, wholesome and unadulterated fish and fishery products and that it is the responsibility of States to adopt appropriate measures to ensure those rights.

32. There is some overlap and possible confusion in the use of the three terms, safe, wholesome and unadulterated which can be clarified as follows:

- Safe fish - does not cause illness, injury or death in the consumer - it is harmless. Fish products can be unsafe due to the presence or growth of pathogenic organisms or their toxins (bacteria, viruses, fungi), the presence of biotoxins (for example biogenic amines and ciguatoxins) and parasites, or be contaminated with chemicals or unsafe materials (metal/glass).
- Wholesome fish - is beneficial to health. This word suggests that the fish is not only safe to eat but also has beneficial effects i.e. it is nutritionally good for the consumer. Fish is naturally a nutritious and therefore wholesome food stuff and its wholesomeness cannot be increased, however it is possible through poor processing and loss of quality for nutritional value to be lost and therefore wholesomeness to be reduced. Some authorities also associate decomposition or spoilage with wholesomeness, implying that a spoilt fish has less nutritional value than when fresh or properly processed, which may or may not be so.
- Unadulterated fish - fish becomes adulterated by a deliberate act that aims at deceiving the purchaser/consumer as to its real worth by substitution of inferior substances. This might be in the form of fish of lesser value or other food materials that resemble fish but perhaps do not have the same nutritional value. Adulteration in this context, therefore, is associated with deliberate fraud by the producer of the purchaser or consumer.

33. The immediate hands-on responsibility for ensuring that fish is safe, wholesome and unadulterated rests with the producer(s) of that fish, that is every one from the fish catcher to the retailer, including processors, merchants, distributors and transporters. States, however, have a duty of care towards the population. This duty of care will be best served by legislation which makes it a requirement that fish producers have a functioning, effective safety/quality assurance programme in place; have knowledgeable personnel running that programme and are processing food in hygienic conditions. The State also has a duty to institute a legal framework under which a producer can be prosecuted for putting on the market food, which is dangerous to the health of consumers.

34. Modern food safety and quality assurance systems have, as an underlying principle, the need to show that précautions are taken to safeguard the consumer. The practise of exercising precautionary principles or showing "due diligence" can be used as a defence in the case of prosecution under many legal systems. This requires therefore that the system is transparent and documented so that records can show "due diligence" was exercised.

35. Under some legal systems the final seller of food products is responsible for the safety and quality of the fish they sell even though they may not been involved in the production process. This requires therefore that the seller is satisfied with the standards of production being employed and might require that the seller make "safety audits" of their suppliers. The chain of responsibility for safety goes down through the various levels and will include the fisherman or the fish farmer as the primary provider of the raw material.

36. The incidence of food poisoning or illness associated with the consumption of fish produced through the small–scale sector in developing countries is generally poorly understood. Small–scale, non-industrialised operations may need government assistance in meeting the requirements of hygienic food practices. The education and training of those involved and the provision of basic requirements to ensure that the industry is able to fulfil its obligations in this respect is normally the responsibility of the State.

37. Although fish often plays a vital role in protein security for large portions of the population this role is not always recognised. Unhygienically produced fish may produce hidden costs for the state in additional medical costs, lost working days, reduced fish sales and so on. Reduction of these costs through assistance to the small–scale industry may thus produce dividends. This assistance might include:

- Provision of landing sites through which products can pass without food safety risks.
- Availability of potable water at strategic points such as landings, in processing areas and at markets.
- Marketing facilities for sales at various stages, which meet acceptable hygiene standards.
- Education and training programmes for those involved in the production and marketing of fishery products on the hygienic handling and processing of fish.
- Advisory services to those involved in the industry to assist them in producing safe food.

38. Extension services of fisheries administrations would be the normal channel for these types of activity but in order to function efficiently these services need sufficient funding and appropriately trained staff, including subject matter specialists in fish as food.

11.1.2 States should establish and maintain effective national safety and quality assurance systems to protect consumer health and prevent commercial fraud.

39. The protection of the interests and health of the population must be a priority for any government. An effective food safety and quality assurance system is a basic element in protecting both the health of the consumer and the interests of the industry. The protection of

consumer health can be a function of a number of different government departments depending on the country. It is essential for efficient operation of health inspection and food safety systems that there is co-ordination between the various interested parties. The common arrangement whereby there is an authority responsible for public health and safety of foods as well as a group within a fisheries administration responsible for fishery products can lead to duplication of efforts and perhaps confusion. The first of these authorities will normally be concerned with the protection and rights of consumers whereas the fisheries administration will be concerned with the producers.

40. The system needs to be designed to ensure that the duties and responsibilities of local, national and if necessary extra territorial authorities are understood and that conflicting and/or overlapping rules and regulations are eliminated. The legislation and framework under and through which the organizations work and collaborate need to be agreed through thorough consultation between the various parties.

41. The basic foundation, a food law and a national food safety control strategy will need backing by a food safety control service which has inspection, analytical, compliance and certification functions and abilities.

42. Not only can a case be made that there should be pooling of resources and elimination of duplication within a national administration, but the burdens on struggling economies of setting up and operating specialist services for analysis and inspection, for instance, suggests that regional pooling of resources is worthwhile in some circumstances.

43. The broad global acceptance, of food safety and quality assurance systems which include Hazard Analysis Critical Control Point (HACCP) principles make these systems currently the systems of choice in food production industries. Many countries or groups of countries require, or will require, that HACCP be used both domestically and for imported products. This suggests that government investment in the manpower and infrastructure to ensure that the national industry is able to comply with these systems is needed. HACCP is, in essence, a system of self–regulation which requires that individual producers analyse the hazards and risks involved in producing their products and then carry out monitoring, auditing and verification of their own operations to ensure that the risks are reduced to acceptable levels.

44. Although HACCP–based quality assurance systems have been used for and are primarily thought of as means of ensuring safety of products they can and, in reputable companies, will be used to ensure quality and conformity to the companies standards and specifications for particular products; to control instances which do not indicate immediate safety problems but which can compromise the "quality" of the product and may have commercial and financial implications for the company.

45. These systems largely do away with the need for continuous end product inspections. For this reason very large official food control agencies may not be necessary. Smaller units staffed by well trained, motivated and educated personnel providing periodic advice and

monitoring are probably all that is required, once the industry has taken on-board and is operating HACCP based systems. These responsibilities may be delegated to specialist private companies who with accreditation from the appropriate government agency are given the authority to undertake the required inspection and certification.

46. A number of safety hazards may exist, however, which are beyond the control of individual companies or the industry as a whole. These might include environmental changes or pollution such as red tides, oil spills or chemical pollutants in water bodies, which can affect the safety of raw materials. For these types of hazard a government agency must take responsibility on behalf of the industry and consumer for monitoring and control. These types of hazard will require that the relevant authorities have the ability to detect that they are present and the power to close or restrict harvesting from a particular water body until the hazard has passed or safety of products can be assured.

47. Consumer protection against fraud is an important aspect highlighted in the Code, which encourages States to establish and maintain effective systems to detect, deter and prevent commercial fraud. Commercial fraud by its nature is designed to deceive so as to generate undue profit and will therefore be difficult to detect. This fraud may take a number of forms, for instance:

- Mis-identification of fish species and species substitution
- Wrong weights on packages
- Deliberate under packing
- Excessive use of additives (e.g. phosphates to increase water content)
- Inaccurate weighing at retail level
- Mislabelling of country of origin

48. If a company is determined to practice fraud it will do so and the responsibility of the State is to put in place mechanisms which make it more likely that perpetrators will be caught and if caught that they will be prosecuted. Spot checks on weights and measures used in the manufacture and sale of goods, analysis of end products for composition and conformity to standards and open channels of communication between the public and the authorities so that suspicions can be reported, are possible means of deterring fraud.

49. The use of quality assurance systems in which all employees in a production plant are involved can also assist in making it more difficult for fraud to occur since a larger number of people would need to be involved in the deception and cooperation and confidentiality assured for it to go undetected and unreported.

50. Some fish species are very much more valuable than others, however, when packaged and prepared for cooking it is often very difficult to tell one type from another. The temptation to substitute a high value variety of fish with a cheaper alternative can lead to fraud. The difficulties of distinguishing between different species of fish when only the muscle or meat is available are well known. The use of biochemical analysis such as electrophoresis can be used

to differentiate between different species and in cases of legal proceedings being instigated for fraud it may be needed.

11.1.3 States should set minimum standards for safety and quality assurance and make sure that these standards are effectively applied throughout the industry. They should promote the implementation of quality standards agreed within the context of the FAO/WHO Codex Alimentarius Commission and other relevant organizations or arrangements.

51. In order for States to be able to ensure that consumers rights are protected it will be necessary that some minimum standards of safety and quality assurance are set. The Joint FAO/WHO Food Standards Programme, which operates chiefly through the Codex Alimentarius Commission (CAC), was set up primarily to protect consumers against health hazards and fraud, to ensure fair practices in food trade and to facilitate international trade in food.

> The main purpose of the joint FAO/WHO Food Standards Programme is to protect the health of consumers and to ensure fair trading practices in the food trade; to promote co-ordination of all food standards work undertaken by international governmental and non-governmental organizations; to determine priorities and initiate and guide the preparation of draft standards and codes of practice through and with the aid of appropriate organizations; to facilitate standards and codes of practice and after acceptance of the standards by governments, publish them in a Codex Alimentarius either as regional or world-wide standards.

52. The promotion and use of Codex Alimentarius Commission (CAC) quality standards is encouraged by the Code as a base line from which a set of national standards can be produced. As is acknowledged in CAC documents, the contents of the codes of practice and standards are designed to give guidance to national governments on the elaboration of local legislation taking into account local circumstances.

53. The codes of practice produced by the Codex Alimentarius Commission provide useful checklists of requirements for national enforcement authorities. The Codex standards are designed as minimum standards to be used as **soft** law, in other words a series of non-mandatory rules or guide lines which should be used as guidance for countries wishing to formulate their own legal frame work, to make **hard** law. However, the need for countries wishing to export fishery products to take into account the requirements of the importing country must not be overlooked in establishing national legislation. Small–scale artisanal fishing operations supply a large and growing portion of fish exported from developing to developed countries. A fish landing site which is used both for fish destined for local

consumption and for export would most sensibly be designed, run and managed so that it meets the requirements of the most stringent of the two sets of requirements. In most cases these will be the requirements of the importing country, over which the local authorities have little control.

54. The World Trade Organization (WTO) has reached agreements on Sanitary and Phytosanitary Measures and Technical Barriers to Trade. These place obligations on nations to ensure that Sanitary and Phytosanitary measures have a truly scientific justification and are not arbitrarily or unjustifiably discriminating between nations. Under these agreements countries are also required to apply the same standards to food produced domestically as they do to imported food. These provisions are written into legislation such as that in force in the European Union and the United States of America requiring countries wishing to import products to conform with procedures laid down by the importing countries.

55. It is a provision of the WTO agreements that conforming to standards produced in an international setting, such as Codex Alimentarius, implies complying with the Sanitary and Phytosanitary measures. This thus increases the importance of CAC tremendously and countries are urged to support and promote the work of the CAC.

56. The Codex documents include provisions on the hygiene and nutritional quality of foods, food additives, pesticide residues, contaminants, labelling, and methods for analysis and sampling. The constant review of these documents by the various Codex Alimentarius committees, based on international consensus and sound scientific concepts, makes them the accepted minimum standards, but more stringent standards might be adopted if high risks are found in certain areas.

11.1.4 States should cooperate to achieve harmonization, or mutual recognition, or both, of national sanitary measures and certification programmes as appropriate and explore possibilities for the establishment of mutually recognized control and certification agencies.

57. The Code recognises that it is unlikely that identical sanitary measures and certification programmes in different countries can be achieved, given the diversity of industry, government and legal systems between States.

58. What is more achievable and equally valid, as far as the responsibility of the various parties involved in protecting consumers are concerned, is that there should be confidence that the measures and programmes achieve the same objectives. This is the principle of equivalence.

59. The principle of equivalence recognises that there are a number of ways of achieving the same objectives (production of safe food for instance). The principle is that as long as the programme and methods can be seen to be clearly defined, enforced, scientifically valid and verifiable as to their effectiveness then States should recognise each other systems as being

"equivalent". (Sophonphong and Lima dos Santos 1997). This is what is called for by the code when it calls for states to cooperate to achieve harmonisation or mutual recognition.

60. The Codex Alimentarius Commission defines equivalence as the capability of different inspection and certification systems to meet the same objectives. In order that this can happen States need to have systems in place that can be seen to be operative, in other words there is transparency. It is generally recognised that the use of HACCP can play a central role in allowing equivalence to be measured and assists in the process of harmonisation.

61. Harmonisation between exporting and importing countries through the mutual recognition of the authorities responsible for ensuring safety of food implies cooperation between states and assistance usually between exporting and importing states to bring less developed systems to the levels required. In some instances there is a strong case to be made for a number of countries sharing facilities for analysis, monitoring, control etc.

62. In determining equivalence of a national food safety control system it is not sufficient that States simply accept international standards or guidelines as a basis for their legislation, there must be assurances that the standards and guidelines are applied and met by ensuring, *inter alia*, that the following exist:

- necessary legislation, regulations and infrastructure covering fish handling and processing;
- a national food safety control programme;
- a national programme for pollution monitoring, presence of biotoxins and other items which may influence the safety of fish products;
- trained staff able to provide technical support for the implementation of quality assurance programmes in the industry and able to audit and verify such programmes;
- resources and commitment to enable staff to keep in touch with on–going developments through participation in international meetings and fora on quality assurance;
- refresher and updating training for regulatory personnel and training schemes for industry personnel in quality assurance.

11.1.5 States should give due consideration to the economic and social role of the post–harvest fisheries sector when formulating national policies for the sustainable development and utilization of fishery resources.

63. The role of governments should be to secure a sustainable and balanced development of both the harvesting and post–harvest fisheries sector. Thus one of the central issues in most capture fisheries is the need to match the catching and the processing/marketing sectors of the industry. If the latter is too large it may lead to unacceptable pressure on fish stocks or if too small it may result in the loss and wastage of fish because it cannot be processed, marketed and consumed before it spoils. The formulation of a sound policy is required, which takes into

account all the various factors involved and needs and concerns of all, from fish capture to consumer (including environmental groups). Governments will play a key role in facilitating the provision of the tools required for implementing policy and establishing a conducive environment for it's fulfilment. These may include physical, fiscal and legal frameworks to assist in the process of development.

64. The post–harvest sector is a vital, but sometimes neglected, part of the fishing industry. Without effective and sustainable sales and marketing of fish and fishery products the other aspects of the industry could be in jeopardy or cease to function. Such industries as fish catching, aquaculture, boat building, gear construction, transportation facilities, fish processing, packaging, ice production etc. would not be sustainable without the sale of the end product, "fish", to consumers. It is the money created by the sale of fish which enables the other parts of the industry to survive and feed back into the industry.

65. The small–scale fishing and fish processing industry in less developed countries provides a vital and much needed source of valuable protein to many people. Often however persons at the lower end of the income and social scale who are on the knife-edge of subsistence undertake these activities. States are urged to take due consideration of the post–harvest sector in formulation of national policies for the sustainable development and use of fishery resources taking into account the social and economic well–being of the small–scale industry and their role in food security. Understanding the needs and aspirations of the small–scale industry is a pre-requisite of being able to plan and implement meaningful and sustainable interventions. The use of participatory appraisal techniques to gather and disseminate information and channelling activities through Non-governmental Organizations (NGOs) have been found to be successful in raising standards in the small–scale fish processing industry of some less developed fishing communities.

66. The commitment of States to protection of the post–harvest sector and, *inter alia*, the whole industry needs to be recognised in the allocations of research and development funding. The social and economic interaction between artisanal and industrial activities and the consequences of interventions on the various sectors need to be fully considered in development plans for the fishing industry.

67. In most capture fisheries there is a need for infrastructures that are shared and used by more than one fisherman or fishing enterprise. Economies of scale in providing landing facilities for a whole fleet rather than each vessel having its own landing place are usual. Such items as fish harbours providing safe anchorage, landing facilities for unloading catches, market halls provided with equipment for ensuring clean and hygienic handling of the catch for sale are often established through government or government supported organizations. The costs for providing these facilities may be met from the general exchequer or by a levy on those using the facilities or a combination of the two.

68. There may be a role for government in running and providing more tangible needs such as ice provision and cold storage in support of the post–harvest sector, but generally this type

of activity seems to be best left to the private sector free, from the bureaucracy of publicly funded operations.

69. Para–statal companies dedicated to fishing, fish processing, marketing and distribution have in the past been seen by many governments in developing economies as an appropriate means of stimulating the development of industrial fisheries. However, many have not succeeded in fulfilling their objectives. The over–optimistic prediction of fish catches and market flows with over–capitalisation of assets from the start, coupled with often conflicting social and commercial objectives contribute to the problems. Some factors that seem to mitigate against successful and sustainable establishment of para–statal fishing enterprises include, political interference in their operation, the inability to react to commercial and market pressures, to hire and fire staff, when necessary, and inflexible management.

11.1.6 States and relevant organizations should sponsor research in fish technology and quality assurance and support projects to improve post–harvest handling of fish, taking into account the economic, social, environmental and nutritional impact of such projects.

70. Fish as a food product is derived from very variable raw material. Unlike most food products that rely on one, or a small number, of varieties of a single species as raw material there are a large number of species of fish harvested and marketed for food. For example the FAO annual statistics of fish catches and landings (FAO 1997a) group together similar fish rather than list all species but still there are approximately 1 080 categories.

71. There is not only variation in composition between species but the same species can vary from season to season and from place to place. This wide variation makes it difficult to take the results of research and technological development in one set of circumstances or on one fish type and say with any certainty that the same outcome will be achieved, on another fish or in another set of circumstances. In addition to the large number of species already being harvested the need is also apparent to investigate the marketing and post–harvest handling and processing characteristics of novel species with a view to assisting in remedying the shortfall of fish supplies which seems likely in the future.

72. Not only are there a great number of varieties of fish available as raw material to the post–harvest sector; there are also a large number of different markets and product types for those markets. Fish is sold, fresh, chilled, frozen, heat treated, fermented, dried, smoked, salted, pickled, boiled, fried, freeze dried, minced, powdered and in ways where a number of these processes may be combined. For each of these types of process, the fish can be prepared and packaged in a myriad of different ways depending on location and market demands.

73. The different levels of development and scales of operation found in different parts of the world exacerbate the differences between species. What is appropriate in an industrialised fishery is often not appropriate for a small–scale artisanal fishery in a developing country. The differences are particularly marked in considering the differences between commercial fisheries in temperate developed countries and small–scale fisheries in tropical developing countries. In

the first case it could be that a small number of species are being processed, in a favourable environment and with a well developed infrastructure and in the second case, a large number of species, in a harsh environment, with little infrastructure.

74. Given these uncertainties the need for adaptive research is strong.

75. The role of the public and private sectors in funding and supporting such research will vary between countries. It would seem, however, most appropriate for State support to be extended towards a number of areas which impinge on the public at large and which no one private company is likely to see as priority for research. The need for research into the socio–economic conditions, particularly in small–scale fisheries in less developed countries, is apparent so that the basic data for fisheries and developmental policies is available and further research needs can be pinpointed. In order for these research activities to be undertaken a resource base of institutions and manpower with the required education and skills are needed. Research activities might include the following:-

- research on protection of the health of the consumer, inspection and quality assurance. The development of quality assurance and inspection systems, standards and guidelines to ensure public safety and the promotion of confidence in the public that fish and fishery products are safe and healthy food stuffs. This might also include basic research into the ecology and physiology of pathogens, for instance, which can form the basis for the quality assurance systems and guidelines to be incorporated into legislation.

- newly discovered species or identified stocks, which show potential for further development into the human food chain, may require basic nutritional and biochemical studies, chemical composition, analysis of yields and storage trials which would form the basis for private investment later.

- research into marketing opportunities for newly discovered species.

- environmental impact research such as:

    - more efficient use of water and energy,

    - the use of alternative methods of insect control to reduce the use of harmful pesticides, (particularly in developing countries where natural drying is practised),

    - the efficiency of fish smoking systems to reduce the amount of wood required, (particularly in developing countries where smoke drying is an important means of preservation to ensure fish reaches the consumer),

    - the effect of effluent and waste materials from fish processing on the environment,

    - the effect of waste–water from processing operations on other industries such as aquaculture.

- means of reducing post–harvest losses and increasing the use of bycatch and under-utilised species (e.g. small pelagics, meso-pelagics), where consistent with sound management of the resources. The need to take into account and research marketing opportunities for novel species and their products is apparent and must be an integral part of the development process for new products.

76. Small–scale fish processing industries in developing countries have particular research needs associated with the need to protect the environment, ensure sustainability of their activities and improve or at least maintain their livelihood. These operators are unlikely to be able to invest in the research activities necessary to tackle the problems outlined above and it will continue to be a role for governments to fund and assist in the endeavours to make post–harvest fishing activities more efficient and sustainable particularly in developing fisheries.

77. States wishing to increase fish consumption should be prepared to assist in financing private sector research. This may appropriately be done through direct financial assistance to private research or through the use of consortia. These consortia may include private industry, research institutions, universities and government all working together towards common goals. In this way the government may be able to ensure that any developments resulting from the research are in line with government objectives, for example towards food security, fish resources and the environment. There are cases where private industry should be asked to fund or subsidise government research institutions to undertake investigations on their behalf.

78. Private sector investment in research and development is more likely to be near–market oriented such as research into product development or research and development of new processing methods and equipment. This type of research is seen as a means of adding value, widening market opportunities and is concerned particularly with increasing the competitiveness, of the particular company funding the research.

11.1.7 States, noting the existence of different production methods, should through cooperation and by facilitating the development and transfer of appropriate technologies, ensure that processing, transporting and storage methods are environmentally sound.

79. Fishing industries can be affected by and have an effect on the environment. This article asks that States facilitate the use of processing, transport and storage methods, which are environmentally sound. To decide what actions are, or are not, environmentally sound takes careful and skilled analysis. In the spirit of the precautionary approach to responsible fisheries, if there are any doubts as to whether a particular course of action is environmentally sound, action should be taken as though it is not sound practice until such time that it is demonstrated otherwise or an alternative strategy or technology is available which is demonstrably environmentally sound.

80. The assessment of environmental impact during the planning of new industries and the weighing up of the impacts and risks from different scenarios and technologies should be a

routine part of government approval procedures for new ventures. Specialist skills are required for environmental impact assessments and evaluation of the various options that might be available.

81. In general fisheries suffer from, rather than contribute to, pollution of the environment. One of the exceptions in the post–harvest fisheries sector is discharge from fish processing plants. Fish processing is more often than not a wet process. Water is used for washing the product and the surfaces with which it comes into contact. It is also used as a means of transporting waste products and contamination away from the working environment. This water picks up material that can have a high biological oxygen demand. If discharged directly into natural water bodies this can cause serious loss in water quality, anoxic conditions and can affect the biological equilibrium of the aquatic environment. In some circumstances it may be considered a source of nutrients, in others of pollution. The materials, since they are biological in nature, may eventually degrade and the effects may only be localised in time and space. However, they should not be ignored, as even temporary or localised habitat disruption can be detrimental. The discharged water may also contain cleaning chemicals and sanitisers used in the fish processing plant which may be less benign. Continuous discharges, even of purely biological material at the same place, can become a continuous threat and local nuisance. Where fish processing operations and aquaculture are in close proximity, the danger of cross–contamination from waste–water and the possible build–up of disease organisms in a closed loop situation must be considered.

82. The removal by physical screening of large pieces of fish should be the first step in elimination of the problem, followed by suitable wastewater treatment, if required. The most appropriate action depends to a major degree on the local conditions. Expert advice, taking into account the legal requirements and current state of knowledge, is required for each location. Solid materials screened from the water or as a by-product from the processing line will normally require special disposal. The use of fish waste for production of further food stuffs (including animal feeds) would seem the most responsible option, however the economics and logistics of such options may not always be favourable.

83. Environmental protection legislation to protect the habitat of coastal waters or other water courses from dumping of waste may have the effect of making waste utilization rather than waste disposal a more attractive proposition. The production of animal feeds, the fuller utilization of trimmings from a filleting line, the drying and use of fish heads may all make economic sense if the costs of disposal are increased because of restrictive legislation.

84. The use and development of fish washing machines, which reduce the requirement for water can assist not only in reducing wastewater volumes but also the amount of water extracted from the environment and the associated costs.

85. In addition to water and solid fish waste certain fish processing activities can cause strong smells. This is particularly so where drying and/or cooking of fish is part of the process. A prime example is the production of fishmeal. The location of fishmeal plants in areas of habitation can be very unpopular with the public and careful planning, taking into account

prevailing winds, is required if future problems are to be avoided. Modern fishmeal processing equipment can be fitted with odour reduction equipment on the exhaust flues and it could be a prerequisite of granting planning permission for fishmeal production that suitable odour reduction equipment is fitted. It is also apparent that the quality of raw material used for fishmeal production affects the production of odours. Poor quality or spoilt raw material gives off stronger odours and coincidentally produces poorer quality meal. Alternative means of producing animal feed supplements from fish, such as fish silage, produce little noticeable odour.

86. Problems of smells can also occur with air/natural drying of fish for human consumption. Under good drying conditions (low humidity, good air movement, correct temperature) fish will dry sufficiently quickly to prevent spoilage mechanisms that produce the volatile odorous substances. The main problems occur when fish begin to spoil before they are dry. This can occur in rainy seasons in tropical climates when it proves impossible for fish to be dried before it spoils. This can lead to not only smells, but problems of disposal of rotten fish, an increase in the number of flies and of course the loss of valuable food from the human food chain. In addition to these immediately noticeable effects, insects (such as flies) can be vectors of human disease and so have the potential to contaminate fish and cause food poisoning problems. The introduction of alternative means of preservation, and the development and transfer of appropriate technologies can assist in the endeavours to over come these problems but the economic and social factors involved in acceptance of innovation are just as important as the technology itself.

87. In order to overcome some of the problems of insects during the production and storage of dried fish a range of chemical insecticides have been used in fish processing establishments and in some cases in direct contact with fish. Many of these substances are recognised to persist in the environment and are potentially harmful to man, if not used properly and under controlled conditions.

88. Only two approved alternatives are available, pirimiphos-methyl and synergised pyrethrins. Unless, however, these alternatives can be shown to be equally effective, are as easily available and are as cost effective as the ones they should be replacing it is unlikely that they will find widespread acceptance. The FAO/WHO Joint Meeting on Pesticide Residues (JMPR) should be consulted for the latest recommendations on allowable levels and means of application. A database of current recommendations can be found on the FAO World Wide Web home page (http://www.fao.org/) under "Statistical Databases".

89. It is quite likely that other pesticides could be effective in protecting fish from insect damage and indeed research work has demonstrated that this is probably so. However the extensive trials necessary to establish Maximum Residue Levels (MRL) for these substances when applied to drying or dried fish have not been undertaken. Without these thorough trials the substances will not obtain recognition and listing by the JMPR and therefore cannot be recommended for use. The fact that fish is a relatively minor commodity and the costs of trials of pesticides can be large, probably precludes the pesticide producing companies from applying for recognition for the use of the alternatives for use on fish and fish products.

90. Natural substances such as spices, fruit juices and plant extracts have been used traditionally in some fisheries for insect control on dried fish. Further research into the effectiveness and isolation and/or purification of the active ingredients in these naturally occurring substances may provide environmentally safe and healthier alternatives for insect infestation control.

91. There has also been interest in isolation of toxins produced by the *Bacillus thuringiensis* (Bt) bacterium as an agent for control of insect pests of dried and drying fish. These toxins, which have insecticidal properties, are generally accepted as a means for control of insect infestation in other food crops, can be very specific in their action and have low environmental persistence post-application. This may be another promising line of investigation for an environmentally benign means of reducing post–harvest losses and ensuring greater utilization of fish products.

92. The reduction and phasing out of the use of ozone depleting substances used as refrigerants is called for by the Montreal Protocols. Other articles of the Code of Conduct (8.8.2 - 8.8.5) call specifically for the phasing out of the use of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in fishing vessel refrigeration systems. The same provisos apply equally to the land based refrigeration systems associated with fish preservation and processing. In addition to the ozone depleting effects of fluorocarbons they are also classified as greenhouse gases. CFCs and HCFCs are being replaced under the Montreal Protocols by fluorocarbons (HFCs) with much lower or negligible ozone depleting potential.

93. Unfortunately HFCs have high Global Warming Potential and are like CFCs and HCFCs classed as greenhouse gases. There are therefore moves within the United Nations Convention on Climate Change to reduce the emissions of HFCs as well as the CFCs and HCFCs already covered under the existing protocols. These factors indicate that there will probably be a reversion to some of the more traditional refrigerants such as ammonia and the development of refrigerant gases with both low ozone depletion properties and low global warming potentials. Present indications suggest that there will be further development in the use of hydrocarbons such as propane and isobutane which have no ozone depletion effect and direct global warming potential and are already in use in small–scale domestic applications.

94. CFCs have also been used as blowing agents for the production of insulating materials such as polyurethane foam, which is used extensively in refrigerated storage and as an insulator in other low temperature applications in the fishing industry. The use of alternative blowing agents has been developed based on hydrocarbons, notably cyclopentane.

95. Competent authorities have an obligation to inform the refrigeration and construction industries of the requirements to use alternatives to CFCs and HCFCs in new installations and to refit existing plants with non-ozone depleting refrigerants. CFCs and HCFCs from redundant installations must be disposed of in an approved environmentally friendly manner and will be the responsibility of States to see that this is done. Given the specialised nature and unforeseen costs of these operations it may be appropriate for States to assist industry in

meeting dead-lines for this and taking on the responsibilities for safe disposal of the substances involved.

96. Those involved in the maintenance and repair of refrigeration equipment need to be kept informed and given training and instruction in the use and handing of replacement substances and to be made aware of the procedures for there safe and responsible use.

97. Under the Montreal Protocol, signatories have also agreed to a phased reduction in the use of methyl bromide because it is has strong stratospheric ozone deleting potential. Methyl bromide is used as a soil fumigant and for the fumigation of foodstuffs (mainly fruits and vegetables) against insects in storage. It has been used to a minor extent for fumigation of dried fish and dried fish stores. Chemical alternatives, which are being advocated for fumigation of foodstuffs, include phosphine and carbonyl sulphide. Phosphine has been demonstrated to be an effective fumigant for dried fish but as with all potentially lethal procedures, users need guidance in its application. Non-chemical alternatives that may be appropriate for use on some foods include irradiation, controlled atmospheres utilising nitrogen and carbon dioxide, and temperature modification.

11.1.8 States should encourage those involved in fish processing, distribution and marketing to:

a) reduce post–harvest losses and waste;

98. It is widely recognised that not all fish that is harvested with the intention of being used for human consumption actually reaches the consumer. Some fish is lost from the distribution chain because of imperfections in the technology and/or the handling procedures and some because it has no market and is deliberately discarded. There may be actual physical losses but there also may be losses in value, again because of imperfections in the distribution, preservation or processing technology or losses in nutritional value because of processing and preservation conditions.

99. The magnitudes of the various types of loss that occur between capture and consumption are notoriously difficult to measure at the macro level. The dispersed nature of many small–scale and less developed fishing operations make it virtually impossible to make definitive estimates of post–harvest losses in all but a short time frame and in a relatively small sample of a larger fishery. In addition, in many fisheries there are seasonal differences, not only in fish caught but the conditions under which processing takes place which mean that extrapolation of losses at a particular time to a longer time frame are not feasible. The estimation of losses from one particular cause at a particular point in time and space may be measured with some accuracy. But the extrapolation of these figures to cover a longer time period and a greater area may not be valid and can lead to inaccuracy. It is probable also that research into post–harvest losses is concentrated on scenarios where there are perceived to be high losses whilst there may be little research where there are small perceived losses. This research site bias could lead to over estimations when these findings are used to extrapolate

further. This said, it is generally recognised that the losses of fish between harvest and consumption are unacceptable and efforts are required to reduce them.

100. Under these circumstances there are few verifiable estimates of post–harvest losses but it is thought that in some developing country situations it could be as much as 25 percent of fish caught. Among the factors that may contribute to this situation is the lack of or inadequate use of ice, lack of adequate insulation, poor handling of the product, inadequate road infrastructure and wasteful forms of processing. In Sub-Saharan Africa recent investigations suggest that losses may be only around 5 percent of total artisanal production (FAO 1996) other studies put the figure for the West African region at between 10 and 20 percent (McConney 1994). Losses in value terms to the producers and traders may be higher, however, as the small–scale sector is often unable to prevent rapid deterioration of product quality in terms of freshness, insect damage, breakage, oxidation etc. This leads to recurrent potential losses of value and income to small–scale operations but, conversely, can provide a valuable source of affordable food to poorer sectors of the population.

101. The need for continuing efforts at improving the system for getting fish from the water to the consumer is apparent and efforts by government bodies to encourage better utilization should continue. These would include research and development of both new technologies and new marketing opportunities, training of personnel and provision of infrastructures which might be used by all. The provision of better road access, clean water supply, electricity or telephonic communication to an isolated fishing village, for instance, could greatly enhance the standard of living of all villagers and have positive benefits for fish distribution and marketing, leading to lower losses.

102. Inadequate wholesale and retail fish markets in many developing countries contribute to the wastage and may reduce the level of consumer demand. In many countries, both public and private sector investments in the distribution chain would result in considerable increases in the quantity and quality of fish available for consumption. Not only can a lack or inadequacy of physical marketing facilities be a constraint to efficient marketing but lack of marketing intelligence can also be a factor. The collection and publishing of information on prices, market trends and opportunities can stimulate and assist the sales of fish to the benefit of the industry.

103. The reduction of post–harvest losses can have a number of benefits apart from the immediate increase in the fish reaching the market place. These include the reduction of pressure on fish resources, increased income to the fishing industry and individual processors, greater food security and health for the population. The fact that less fish is wasted means that there will be less fish requiring disposal into the environment and so the environmental impact may be reduced.

104. It is probably true that post–harvest losses can never be totally eliminated, as no system will ever be perfect. The reduction of losses to acceptable levels taking into account the social, economic and environmental costs of doing so must be the responsible goal.

11.1.8 States should encourage those involved in fish processing, distribution and marketing to:

b) Improve the use of bycatch to the extent that this is consistent with responsible fisheries management practices;

105. In addition to losses of fish through poor preservation after harvest, large quantities of fish are lost from the system because they are caught by accident, are not wanted by the fishermen for sale and are consequently thrown back into the water (usually dead). The accidentally caught fish (and other animals) is often referred to as bycatch and that portion which is thrown back into the sea dead is called discards.

106. Almost all commercial fisheries produce bycatch of one sort or another and the amount of the bycatch which is used (or conversely discarded) depends on many factors. Where the bycatch comprises species or specimens which endanger the sustainability or viability of an ecosystem, fishery or species then efforts should and are being made in many instances to reduce or eliminate the take of these species or, if they are taken, to enhance their chances of survival on return to the water. These efforts have focused particularly on species such as turtles, sea birds, and aquatic mammals and on reducing the catch of juveniles of commercially important species.

107. Reductions can be achieved by technological changes in the way in which fish are harvested, by restrictions on when and where fishing can take place and by management and legal means which restrict and control the way in which fishing is practised. Whilst recognising that it is necessary in many cases for these measures to be taken for conservation reasons it is also unrealistic to expect that bycatch and discarding can be eliminated entirely. In some cases it is arguable as to whether it needs to be eliminated from an ecological viewpoint.

108. A very large proportion of what is commonly referred to as bycatch comes from shrimp trawling operations in tropical and subtropical waters. (Alverson *et al* 1994) These fisheries often earn valuable foreign exchange for poorer countries and the fact that the bycatch they produce and discard is being caught adjacent to countries often poor in protein foods should give incentives for more complete utilization.

109. The fish in shrimp bycatch are generally small, mixed species and comprise juveniles of species that will grow larger and may be of commercial value in other fisheries and adult specimens of naturally small species. By its very nature therefore, it causes problems for utilization. In the first instance it is often used as an animal feed. In many countries the bycatch is landed and simply sundried at or near the coast and then used as feed for chickens or other livestock. In other situations fish from bycatch is distributed and sold fresh for feeding direct to fish in aquaculture systems.

110. These are probably the simplest examples of use of the bycatch but more technologically advanced systems for the production of human foods exist for selected species

that have found acceptance in some countries and contribute to food security and income generation. The support from research and development bodies sponsored by governments has been instrumental in identifying marketing and product development opportunities and has an important role to play in reducing the potential losses that discarding at sea represents.

111. In tropical developing country shrimp trawl fisheries there appears to be a relationship between the degree of sophistication in shrimp trawling operations and the amount of the bycatch that is used. Small, relatively unsophisticated trawlers, operating close to shore, spending only a few days at sea and, using ice for preservation of the catch, generally discard less of their bycatch than vessels spending longer at sea and using freezing at sea techniques for preservation of the catch. There are technological, sociological and managerial reasons which make this scenario common, including the time at sea, the relationship between boat owners and crew and the ability of the crew to sell the fish either at sea or on shore to their own advantage. On the other hand, larger more sophisticated operations may be in a more favourable position with regard to reducing bycatch capture by the introduction of improved and more selective fishing gear. There may also be greater public pressure for change on this sector than on the smaller scale, more traditional sector.

112. The search to find uses for this fish as a contributor to human food supplies has the potential to assist in food security, reduce pressure on fish stocks and provide employment opportunities in the manufacture, distribution and marketing of products. Work to date has demonstrated that the main forces, which dictate whether bycatch use is feasible, are economic/market oriented rather than technical.

11.1.8 States should encourage those involved in fish processing, distribution and marketing to:

c) use the resources, especially water and energy, in particular wood, in an environmentally sound manner.

113. The fish processing industry also makes demands on natural resources that have environmental consequences.

114. A constant supply of clean fresh water is needed in many fish processing industries. In planning the siting of industries therefore the availability of water supply must be ascertained and the long-term effects on that supply gauged. Careful design, site layout, processing operations and management can optimise the use of both water and energy, thus contributing to economic efficiency of the company and also reducing the environmental impact of the operation. The long-term extraction of ground water supplies may have environmental consequences, such as salination of the water supplies, lowering of ground levels and lowering of water tables. These in their turn may have social consequences in that communities may be deprived of potable drinking water supplies. The competing uses of the water resource by other industries and for household use must all be taken into account in assessing the ability of a water resource to cope with intended extraction rates.

115. Studies have shown that the highest demand for water in fish processing is often at the stage of washing fish. Whilst not compromising the efficiency of cleaning, machines are being developed which use reduced amounts of water. These machines have further benefits in that they reduce the amount of waste–water created, and requiring treatment, before discharge into the environment. (Zugarramurdi *et al* 1995)

116. Throughout the world fish is smoked to give it flavour and/or to preserve it by removing water and depositing preservative chemicals on its surface. The unsustainable clearing of forest for use as a fuel for fish smoking has been raised as a cause for concern in many areas where traditional fish smoking is practised. This has lead to the development of more fuel-efficient smoking kilns for use in rural communities. However, smoking of fish is not the only use of forest wood in many fishing communities, as wood may also used as a fuel for cooking for instance. Thus work on the introduction of more fuel efficient cooking methods may also have environmental benefits.

11.1.9 States should encourage the use of fish for human consumption and promote consumption of fish whenever appropriate.

117. Fish plays an important role, not only as a direct contributor to human diets, but also in the production of animal feeds, particularly fishmeal. Approximately one third of fish caught world-wide in recent years has been converted into animal feed products. This is not the most efficient means of utilization of fish resources if the aim is to provide food for humans. It might be thought that ideally only fish which is unsuitable for human consumption, because of their nature or because they create difficulties in processing or marketing should be used for non-food purposes. However, large quantities of small low–value fish are converted to animal feeds that could be used as low–cost human food.

118. These are mainly small pelagic species and the difficulties of handling, processing and marketing these small fish for human consumption instead are significant. Although it is technically possible to market them fresh or to produce nutritious food from these fish the main problems associated with their current exploitation are generally institutional, economic and trade related.

119. Where abundant supplies of low–value species are landed for which no economically viable market is immediately available, the costs of preservation and transport to demand centres may mitigate against human food use. The production of animal feeds or fertilisers may be an option that will ensure that the fish are not lost from the food chain altogether. In addition the industries which rely on fishmeal as raw material such as livestock husbandry and aquaculture are themselves important employers and suppliers of food. Aquaculture for example can be an important earner of foreign exchange as well as providing fish to inland areas where other sources of protein rich food may not be available. These macro–economic factors need to be assessed and balanced in determining when it is appropriate to promote use of fish for human consumption.

120. Companies involved in the production of fishmeal are meeting a demand that is likely to continue although there are efforts being made to find substitutes. Fishmeal is an important raw material for feeds in aquaculture systems thus creating important sources of fish, both for earning of foreign exchange and for domestic consumption. Alternative means of utilization of the raw material for direct human consumption may be technically feasible, but unless they can also be seen to be profitable they will not be acceptable to the industry.

121. In some situations, capture of small pelagics for conversion into fishmeal is done through vertically integrated corporations where the same company owns fishing vessels, the landing facilities, the fishmeal plant and the marketing operation thus forming a closed industrial system different from and parallel to the fishery supplying fish for human consumption. Under these circumstances it is often in the interests of the industrial companies to maintain the *status quo* and not encourage the use of the raw material for human food or branch out into new, possibly risky, ventures. It would normally require government assistance in the first instance to encourage these changes. Research into products and market potential for the fish might be the first step followed by incentives and encouragement to the private sector to invest in the necessary further steps to start commercial production.

11.1.10 States should cooperate in order to facilitate the production of value-added products by developing countries.

122. Addition of value to fish within developing countries may produce benefits in a number of ways. In many instances adding value will be equated with exporting the resultant products and earning foreign exchange, which may be important for economic security. The employment of more labour for the tasks of value addition may distribute wealth more equitably and add to the food and economic security of individuals.

123. The demand for convenience foods, ready meals and pre-processed products generally comes from developing countries and an exporter would usually be expected to produce to the specifications of an individual company. This requires that there is cooperation on a company to company basis rather than necessarily on a state to state basis.

124. This article suggests that importing countries of the developed world might assist exporting countries of the developing world in the addition of value to products before export so that foreign exchange earnings can be increased. By adding value, in country, before export it is possible that a greater share of the final value of the products will accrue to the country of origin. Conversely, however these actions will usually involve tying up more capital, taking greater risks and reducing flexibility. The additional processing in developing countries before export may be less costly than processing in a developed country but there may be higher risks involved because of lack of infrastructure, trained manpower and other associated factors.

125. A factor, which may mitigate against the profitability of value addition before export is "tariff escalation" whereby a higher import tariff is applied, by the importing country, on finished or processed products, than on raw materials.

126. Industrialised states could cooperate in facilitating the production of value-added products in developing countries by transfer of technology from the former to the latter. Private cooperation/investment, in the form of joint ventures might be a means of achieving this but requires that the States involved allow such foreign investment and the economic and political climate are conducive to such activities.

127. In other cases adding value may involve producing products of food value from presently under or non-utilised resources. The development of human food products from small pelagic fish presently used for animal feeding comes into this category and should be a factor in responsible fisheries development activities.

128. Exports and value addition can be actively promoted through State intervention. One possibility is the establishment of export promotion organizations, which assist the exporters, and importers to contact one another, assess each other's needs and abilities. These organizations can also play a role on keeping the industry informed of developments regarding legislation, prices and trends that affect the trade and look for new marketing opportunities on behalf of the industry. This type of organization may serve the interests of the whole industry in a country, a particular region within the country or a group of countries. Apart from the activities outlined above the organization might also represent the interests of the industry at international trade fairs, buyer/seller meetings, international and national meetings concerned with trade. Funding for such organizations can come direct from the government, through an industry levy or through a combination of the two.

129. In promoting value addition, of course, there is a danger that poorer sections of the community may be disadvantaged by increases in prices such that they are no longer are able to afford to buy fish. In these circumstances the social and economic consequences need to be weighed against the advantages of increased wealth and employment opportunities and foreign exchange earnings.

11.1.11 States should ensure that international and domestic trade in fish and fishery products accords with sound conservation and management practices through improving the identification of the origin of fish and fishery products traded.

130. The ability to trace the origins of an end product through a system of documentation and records should be a precondition of a well-operated quality management system. Information regarding origin, date and time of capture or harvesting and the various stages of processing and change of ownership should be incorporated into documentation which follows the product to the final sale and the consumer. This type of information can be incorporated into computerised stock control systems by the use of bar codes for instance and can be a requirement to show due diligence and the proper functioning of a quality assurance system. Products entering international trade will normally require traceability of product and a paper trail to be available so that responsibility for poor quality, for instance, can be traced back to particular events. On the other hand it is possible through such documentation to be able to trace good products/suppliers and so be able to repeat orders and build up trade. Not only is such a system a mechanism for assisting in trade but is also assists in protecting the consumer

against fraud and this has been covered to some extent in the section above under Article 11.1.2.

131. It therefore makes sense, from a trade and consumer confidence point of view, to be able to improve the identification of the origin of fish and fishery products. This, however, is not the underlying reason behind Article 11.1.11 above. The reason given for requiring improved identification of the origin of fish and fishery products traded is to accord with "sound conservation and management practices".

132. The concern of the public and consumer about the origins, sustainability and environmental effects of food supplies and the way they are produced is reflected in the recent moves towards the establishment of eco-labelling schemes. Such schemes, which assure the consumer that the product they purchase has been produced in a particular way (without harming dolphins or from sustainable stocks for instance), must be and be seen to be independent and impartial if they are to command world-wide acceptance and trust.

133. Various species and stocks of fish and aquatic organisms are protected from harvesting by international, national or local legislation, custom or tradition. For instance the Convention on International Trade in Endangered Species (CITES) restricts the trade in certain species caught in the wild. It is, however, very difficult to tell whether an item being traded is from protected or non-protected stock. Indeed it can be difficult to tell whether fish flesh is from one species or another let alone whether it is from protected stock.

134. Assuming honesty and due diligence in all parts of the distribution chain a written record of the history of the product would be sufficient to be able to identify the origins of the product and so ensure that sound conservation and management practices have been adhered to. However, it will be and is necessary to be able to identify, for instance, whether a turtle product is from illegally caught stock or from farmed stock, whether eggs from sturgeon (caviar) are from CITES listed species/stock or from others, whether fish meat is of one type or another.

135. Through the use of sophisticated biochemical techniques it is possible to distinguish between species. These techniques, however, are time consuming, expensive and require specialist equipment and knowledge. It seems appropriate therefore that the first steps for assisting in identification of the origin of fish and fishery products should be the establishment of a routine paper trail system which requires that information on the origin of the raw materials should accompany the goods from capture to final sale.

136. It should be a requirement that sellers of products are able to show that they have taken every care to ensure that the product for sale was not illegally harvested. One means of showing that this due diligence is being maintained is to be able to produce the "paper work" that goes with the product. Only in exceptional circumstances will it be feasible and necessary for more sophisticated biochemical testing to be done. The use of "paper trail" type identification and tracking systems are likely to meet resistance from fishermen, fish processors

and traders. As has been said a similar system is an integral part of a quality management system and is expected to be in place for compliance with quality assurance systems.

11.1.12 States should ensure that environmental effects of post–harvest activities are considered in the development of related laws, regulations and policies without creating any market distortions.

137. The protection of the environment from the activities of man is seen as an important aspect in the control of human activities. Post–harvest fisheries activities can, if uncontrolled, cause environmental damage and States should seek to regulate and minimise environmental damage by including on the statute books, legislation which enables action to be taken against those responsible for actions contravening those regulations. In most cases the legislation will not be specifically aimed at post–harvest fisheries activities but be more general in nature. For instance there might be legislation on standards for waste water discharge into water courses, the use and control of specific chemicals such as insecticides, the disposal of plastics into the environment, disposal of solid wastes from food processing establishments and air pollution controls.

138. These regulations and legislative arrangements must be seen to be applied and enforced, equally and fairly, across all sectors of the industry. Policies that might be designed to assist in the development of a particular sector or group within the industry must not be allowed to circumvent the environmental protection legislative framework giving them unfair advantages over others.

139. The establishment of eco-labelling schemes that are designed to promote a responsible and sustainable fishing industry, whilst reassuring the consumer that products have been produced in an environmentally friendly manner, must be seen to be fair and transparent. The Rio declaration following the 1992 UN Conference on Environment and Development said "Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global problems should, as far as possible, be based on an international consensus." The work of the Committee on Trade and the Environment of the World Trade Organization in seeking to clarify the situation. This committee seeks to ensure that environmental issues are not used as hidden non-tariff barriers to trade whilst endorsing and supporting multi–lateral solutions based on international cooperation and consensus.

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These guidelines have been produced to support the implementation of the Code of Conduct for Responsible Fisheries, particularly with regard to the need for responsibility in the postharvest sector of the fish producing industry. The industry that produces fish for food has three major areas of responsibility: ensuring that the food is safe to eat and is of expected quality and nutritional value; ensuring that the resources are not wasted; and ensuring that negative impacts on the environment are minimized. In addition the industry has a responsibility to ensure that the many millions of people throughout the world who work within the industry can continue to earn a gainful living. Article 11.1 of the Code of Conduct for Responsible Fisheries and other related parts of the code are concerned particularly with these responsibilities. This publication provides annotation to and guidance on these articles to assist those charged with implementation of the code in identifying possible courses of action necessary to ensure that the industry is conducted in a sustainable manner.

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